

Wastewater generated from operations at Brookhaven National Laboratory (BNL) is treated at the Sewage Treatment Plant (STP) before it is discharged to nearby groundwater recharge basins. Some wastewater may contain very low levels of radiological, organic, or inorganic contaminants. Monitoring, pollution prevention, and vigilant operation of treatment facilities ensure that these discharges comply with all applicable regulatory requirements and that the public, employees, and the environment are protected.

Analytical data for 2018 shows that the average gross alpha and beta activity levels in the STP discharge (EA, Outfall 001) were within the typical range of historical levels and were well below New York State Drinking Water Standards (NYS DWS). Tritium was not detected above method detection limits in the STP discharge during the entire year and no cesium-137, strontium-90, or other gamma-emitting nuclides attributable to Laboratory operations were detected. Non-radiological monitoring of the STP effluent showed that, with the exception of multiple tolylriazol exceedances, organic and inorganic parameters were within State Pollutant Discharge Elimination System (SPDES) effluent limits or other applicable standards.

The average concentrations of gross alpha and beta activity in stormwater and cooling water discharged to recharge basins were within typical ranges and no gamma-emitting radionuclides were detected. Disinfection byproducts continue to be detected at low concentrations, above the method detection limit, in discharges to recharge basins due to the use of chlorine and bromine for the control of algae and bacteria in potable and cooling water systems. Inorganics (i.e., metals) were detected; however, their presence is due primarily to sediment runoff in stormwater discharges.

The Peconic River remained dry through the first half of 2018, by which time groundwater levels were sufficiently high and led to ponding. By year's end, the Peconic River was flowing offsite. Radiological data from Peconic River surface water sampling show that the average concentrations of gross alpha and gross beta activity from on-site locations were indistinguishable from off-site locations and control locations, and all detected levels were below the applicable NYS DWS. No gamma-emitting radionuclides attributable to Laboratory operations were detected either upstream or downstream of the STP area, and tritium was not detected above method detection limits in any of the surface water samples.

5.1 SURFACE WATER MONITORING PROGRAM

In addition to monitoring discharges to surface waters under the SPDES program described in Chapter 3, BNL routinely monitors surface water quality (including radionuclides) as part of its site Surveillance Program. Although discharges of treated wastewater from the Laboratory's STP into the headwaters of

the Peconic River ceased in October 2014, the Laboratory continues to monitor surface water at several locations along the Peconic River to assess the impact that site operations may have on surface water quality. On-site monitoring station HY is located upstream of all Laboratory operations and provides information on the background water quality of the Peconic

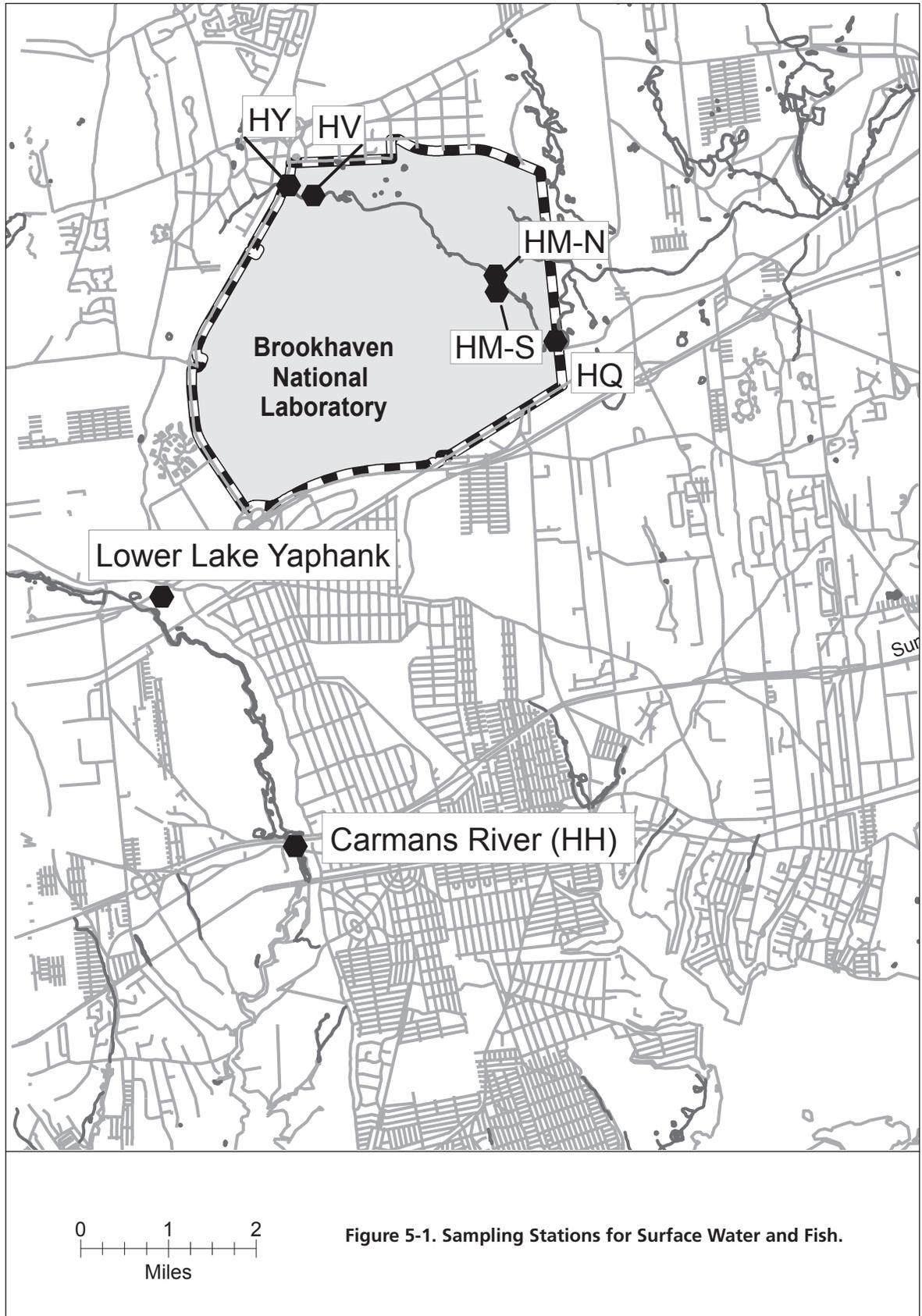


Figure 5-1. Sampling Stations for Surface Water and Fish.

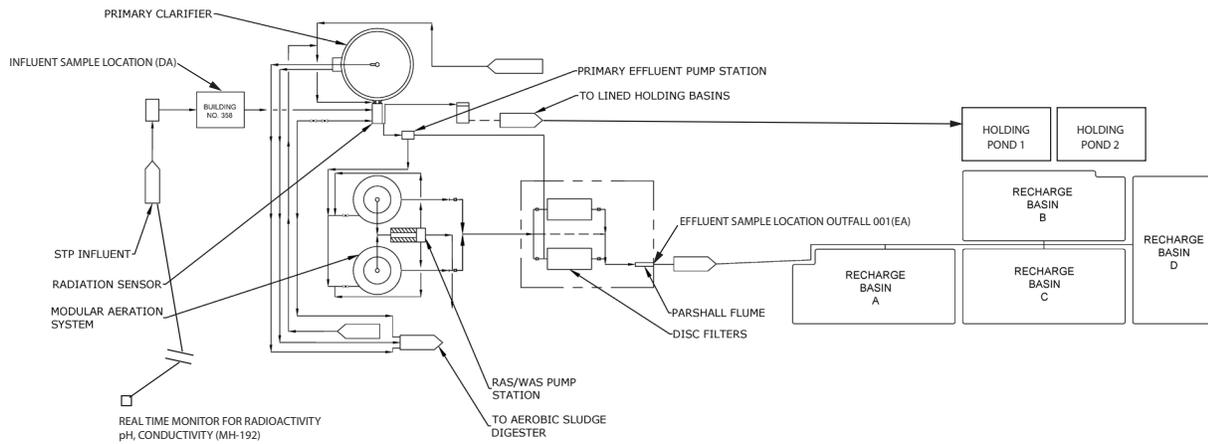


Figure 5-2. Schematic of BNL's Sewage Treatment Plant (Recharge Basin Discharge)

River (see Figure 5-1). The Carmans River is monitored as a geographic control location for comparative purposes, as it is not affected by operations at BNL and is not within the Peconic River watershed.

On the Laboratory site, the Peconic River is an intermittent, groundwater-fed stream. Off-site flow occurs only following periods of sustained precipitation and a concurrent rise in the water table, typically in the spring. There was no off-site flow until the latter part of 2018. The on-site portions of the Peconic River remained dry throughout most of the year as the water table remained low due to drought conditions from 2015 through 2017.

Historical monitoring data indicates no significant variations in water quality throughout the Peconic River system on-site, and pollution prevention efforts at the Laboratory have significantly reduced the risk of accidental releases. The following sections describe BNL's surface water monitoring and surveillance program.

5.2 SANITARY SYSTEM EFFLUENTS

The STP effluent (Outfall 001) is a discharge point authorized under BNL's SPDES permit that is issued by the NYSDEC (Section 3.6.1). Figure 5-2 shows a schematic for discharge of treated STP effluent to nearby groundwater recharge basins. The Laboratory's STP treatment

process includes three principal steps: 1) aerobic oxidation for secondary removal of biological matter and nitrification of ammonia, 2) secondary clarification, and 3) filtration for final solids removal. Tertiary treatment for nitrogen removal is also provided by controlling the oxygen levels in the aeration tanks. During the aeration process, the oxygen levels are allowed to drop to the point where microorganisms use nitrate-bound oxygen for respiration; this liberates nitrogen gas and consequently reduces the concentration of nitrogen in the STP discharge.

Solids separated in the clarifier are pumped to aerobic digesters for continued biological solids reduction and sludge thickening. Once the sludge in the aerobic digester reaches a solids content of six percent, the sludge is sampled to ensure it meets the waste acceptance criteria for disposal at the Suffolk County Department of Public Works Sewage Treatment Facility at Bergen Point, in West Babylon, New York.

Real-time monitoring of the sanitary waste stream for radioactivity, pH, and conductivity occurs at two locations. The first site, MH-192, is approximately 1.1 miles upstream of the STP, and provides a minimum of 30 minutes to warn the STP operators that wastewater exceeding SPDES limits or BNL administrative effluent release criteria is en route. The second monitoring site is at the point where the STP influent

Table 5-1. Tritium and Gross Activity in Water at the BNL Sewage Treatment Plant (STP).

		Flow (Liters)	Tritium (pCi/L)		Gross Alpha (pCi/L)		Gross Beta (pCi/L)	
			max.	avg.	max.	avg.	max.	avg.
January	influent	2.54E+07	< 289	< MDL	< 12.2	< MDL	8.4 ± 1.8	5.5 ± 1.6
	effluent	1.73E+07	< 270	< MDL	< 3.0	< MDL	5.4 ± 1.3	4.8 ± 0.4
February	influent	1.10E+07	< 345	< MDL	< 10.0	4.7 ± 7.0	16.9 ± 4.9	12.4 ± 8.7
	effluent	8.20E+06	< 374	< MDL	2.6 ± 1.6	< MDL	5.4 ± 1.1	4.4 ± 1.8
March	influent	2.40E+07	< 288	< MDL	< 6.9	4.2 ± 2.0	9.7 ± 3.1	6.5 ± 2.5
	effluent	1.71E+07	< 297	< MDL	4.0 ± 2.2	< MDL	5.8 ± 1.5	5.3 ± 0.4
April	influent	3.51E+07	< 307	< MDL	13.9 ± 4.9	2.9 ± 5.5	15.2 ± 3.0	7.7 ± 3.7
	effluent	2.27E+07	< 443	< MDL	< 2.9	< MDL	6.6 ± 1.5	4.9 ± 1.1
May	influent	3.18E+07	< 301	< MDL	8.6 ± 4.6	5.8 ± 2.1	9.6 ± 2.2	6.9 ± 3.0
	effluent	2.00E+07	< 304	< MDL	< 3.1	< MDL	4.9 ± 1.4	4.3 ± 0.4
June	influent	3.62E+07	< 308	< MDL	< 3.9	< MDL	6.7 ± 2.0	4.0 ± 1.8
	effluent	2.53E+07	< 300	< MDL	< 3.6	< MDL	3.8 ± 1.3	3.5 ± 0.3
July	influent	5.62E+07	< 346	< MDL	6.2 ± 2.8	3.8 ± 1.6	7.9 ± 2.2	6.2 ± 0.9
	effluent	3.88E+07	< 348	< MDL	3.0 ± 1.8	< MDL	4.8 ± 1.2	4.1 ± 0.5
August	influent	4.88E+07	< 297	< MDL	< 4.6	< MDL	8.4 ± 2.8	5.6 ± 2.0
	effluent	3.57E+07	< 308	< MDL	< 3.4	< MDL	4.7 ± 1.5	3.7 ± 1.0
September	influent	4.53E+07	< 426	< MDL	< 3.6	< MDL	4.8 ± 1.6	4.1 ± 0.9
	effluent	3.12E+07	< 351	< MDL	< 2.5	< MDL	4.6 ± 1.3	3.3 ± 0.8
October	influent	4.47E+07	< 323	< MDL	< 3.4	< MDL	5.3 ± 1.6	4.6 ± 0.7
	effluent	2.98E+07	< 336	< MDL	< 3.5	< MDL	5.9 ± 1.7	3.9 ± 1.1
November	influent	4.31E+07	< 334	< MDL	4.0 ± 2.5	< MDL	5.6 ± 1.4	3.0 ± 1.4
	effluent	2.50E+07	< 332	< MDL	< 2.1	< MDL	3.9 ± 1.0	3.1 ± 0.6
December	influent	3.59E+07	< 382	< MDL	< 3.2	< MDL	5.6 ± 1.6	4.2 ± 1.0
	effluent	2.57E+07	< 374	< MDL	< 2.9	< MDL	4.9 ± 1.2	3.5 ± 0.9
Annual Avg.	influent			-24.2 ± 28.6		2.6 ± 0.8		5.6 ± 0.8
	effluent			4 ± 24.4		0.6 ± 0.3		4.1 ± 0.3
Total Release		2.97E+08		0.7 mCi (a)		0.2 mCi		1.2 mCi
Average MDL (pCi/L)				346.2		2.7		1.4
SDWA Limit (pCi/L)				20000		15		(b)

Notes:

All values above MDL are reported with a 95% confidence interval.

To convert values from pCi to Bq, divide by 27.03.

MDL = minimum detection limit

SDWA = Safe Drinking Water Act

(a) The total released value for tritium is a conservative calculation that is based on an average of the 95% confidence interval maximums as estimates of monthly average release concentrations. The majority of the effluent samples showed average concentrations less than zero and all results were less than the MDL.

(b) The drinking water standards were changed from 50 pCi/L (concentration based) to 4 mrem/yr (dose based) in 2003. As gross beta activity does not identify specific radionuclides, a dose equivalent cannot be calculated for the values in the table.

enters the treatment process.

Based on the data collected by the real-time monitoring systems, any influent to the STP that may not meet SPDES limits and BNL effluent release criteria can be diverted to two double-lined holding ponds. The total combined capacity of the two holding ponds exceeds six million gallons, or approximately 18 days of

flow. Diversion would continue until the influent water quality would allow for the permit limits and release criteria to be met. Wastewater diverted to the holding ponds is tested and evaluated against the requirements for release. If necessary, the wastewater is treated and then reintroduced into the STP at a rate that ensures compliance with SPDES permit limits for

non-radiological parameters or BNL effluent release criteria for radiological parameters. In 2018, there was one instance where influent water quality required diversion of wastewater to the hold-up ponds. In December 2018, planned maintenance of the 3.2-million-gallon tank associated with the Central Chilled Water Facility required the draining of that tank. Because concentrations of tolyltriazole, used for inhibition of copper corrosion, were above discharge limits, the wastewater was diverted to one of the hold-up ponds, then introduced to the STP at a rate ensuring compliance with SPDES permit limits.

5.2.1 Sanitary System Effluent–Radiological Analyses

Wastewater at the STP is sampled at the inlet to the treatment process, Station DA, and at the STP outfall, Station EA, as shown in Figure 5-2. At each location, samples are collected on a flow-proportional basis; that is, for every 1,000 gallons of water treated, approximately four fluid ounces of sample are collected and composited into a five-gallon collection container. These samples are analyzed weekly for gross alpha and gross beta activity and for tritium. Samples collected from these locations are also

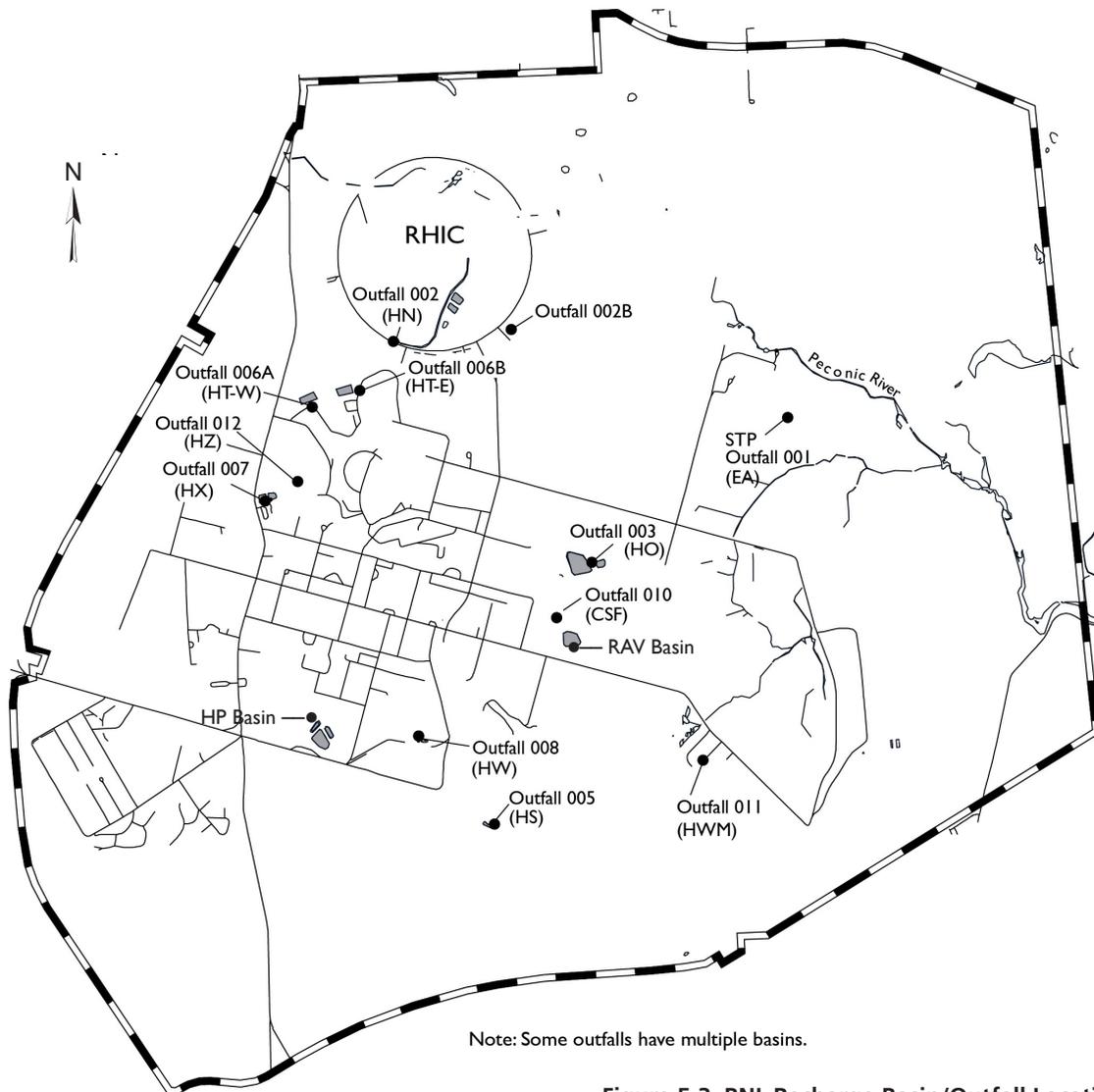


Figure 5-3. BNL Recharge Basin/Outfall Locations.

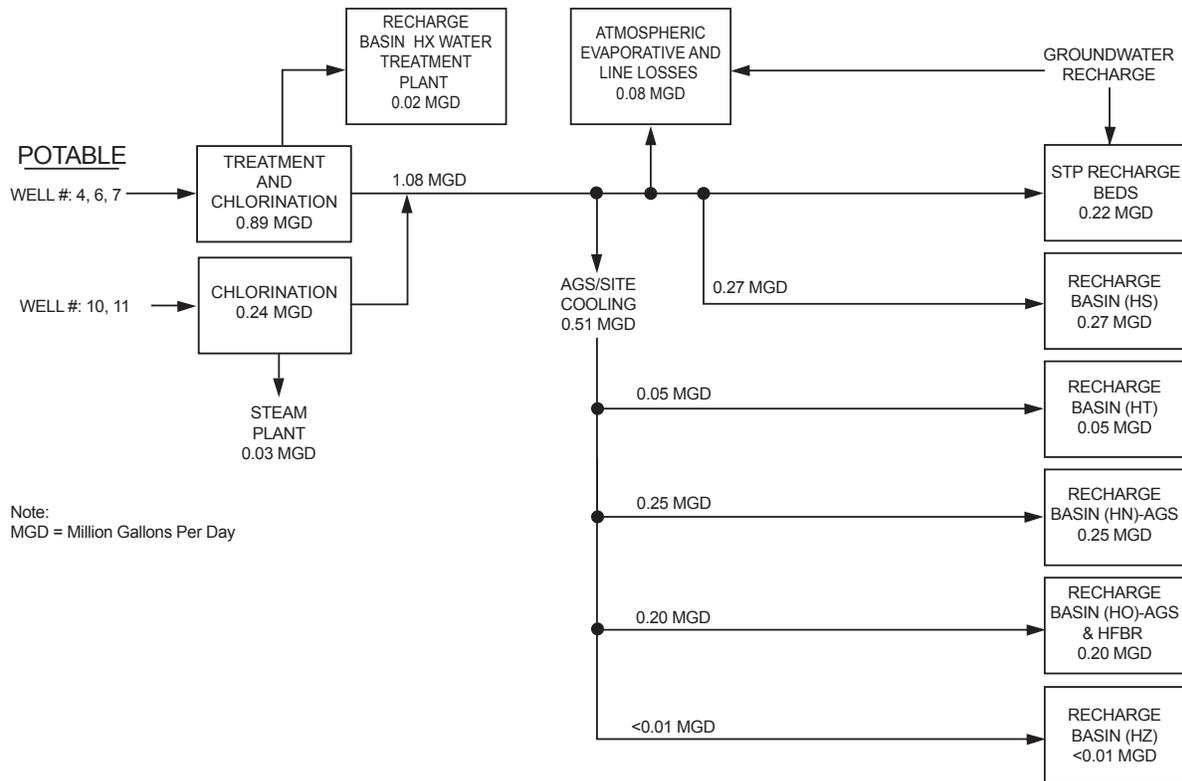


Figure 5-4. Schematic of Potable Water Use and Flow at BNL.

composed and analyzed monthly for gamma-emitting radionuclides and strontium-90 (Sr-90: half-life, 29 years).

Although the STP discharge is not used as a direct source of potable water, the Laboratory applies the stringent Safe Drinking Water Act (SDWA) standards for comparison purposes when monitoring the effluent, in lieu of Department of Energy wastewater criteria. Under the SDWA, water standards are based on a 4 mrem (40 μ Sv) dose limit. The SDWA specifies that no individual may receive an annual dose greater than 4 mrem from radionuclides that are beta or photon emitters, which includes up to 168 individual radioisotopes. BNL performs radionuclide-specific gamma analysis to ensure compliance with this standard. The SDWA annual average gross alpha activity limit is 15 pCi/L, including radium-226 (Ra-226: half-life, 1,600 years), but excluding radon and uranium. Other SDWA-specified drinking water limits are 20,000 pCi/L for tritium (H-3: half-life, 12.3

years), 8 pCi/L for Sr-90, 5 pCi/L for Ra-226 and radium-228 (Ra-228: half-life, 5.75 years), and 30 μ g/L for uranium. Gross alpha and beta activity measurements are used as a screening tool for detecting the presence of radioactivity.

Table 5-1 shows the monthly gross alpha and beta activity data and tritium concentrations for the STP influent and effluent during 2018. Annual average gross alpha and beta activity levels in the STP effluent were 0.6 ± 0.3 pCi/L and 4.1 ± 0.3 pCi/L, respectively, and were below the average method detection level (MDL). These average concentrations were higher than control location data (Carman's River Station HH) reported in Table 5-5; however, they were well below the SDWA standards that are used for comparison purposes. Tritium was not detected above minimum detection limits above MDL in the discharge of the STP (EA, Outfall 001) for the entire year. In 2018, there were no gamma-emitting nuclides detected in the STP effluent.

5.2.2 Sanitary System Effluent – Nonradiological Analyses

Monitoring of the STP effluent for volatile organic compounds (VOCs), inorganics, and anions is conducted as part of the SPDES Compliance Program, which is discussed in further detail in Chapter 3.

5.3 PROCESS-SPECIFIC WASTEWATER

Wastewater that may contain constituents above SPDES permit limits or ambient water quality discharge standards must be held by the generating facility and characterized to determine the appropriate means of disposal. The analytical results are compared with the appropriate discharge limit, and the wastewater is only released to the sanitary system if the volume and concentration of contaminants in the discharge would not jeopardize the quality of the STP effluent and, subsequently, potentially impact groundwater quality (BNL 2014).

The Laboratory’s SPDES permit includes requirements for quarterly sampling and analysis of process-specific wastewater discharged from metal cleaning operations in Building 498 and cooling tower discharges from Building 902. These operations are monitored for contaminants such as metals, cyanide, VOCs, and semi-volatile organic compounds. In 2018, analyses of these waste streams showed that, although several operations contributed contaminants (principally metals) to the STP influent in concentrations exceeding SPDES-permitted levels, these discharges did not affect the quality of the STP effluent.

Process wastewaters that are not expected to be of consistent quality and are not routinely generated are held for characterization before release to the sanitary system. The process wastewaters typically include purge water from groundwater sampling, wastewater from cleaning of heat exchangers, wastewater generated as a result of restoration activities, and other industrial wastewaters. To determine the appropriate disposal method, samples are analyzed for contaminants specific to the process, and the concentrations are compared to the SPDES effluent limits and BNL’s effluent release criteria (BNL 2014). If the concentrations are within

Table 5-2. Radiological Analysis of Samples from On-Site Recharge Basins.

Basin		Gross Alpha	Gross Beta	Tritium
		(pCi/L)		
<i>No. of samples</i>		2	2	2
HN	<i>max.</i>	< 1.79	2.8 ± 1.55	< 455
	<i>avg.</i>	0.33 ± 0.44	1.78 ± 1.99	< MDL
HO	<i>max.</i>	2.06 ± 1.21	1.27 ± 0.73	< 294
	<i>avg.</i>	0.92 ± 2.24	1.16 ± 0.21	< MDL
HS	<i>max.</i>	< 3.64	3.99 ± 1.52	< 333
	<i>avg.</i>	2.01 ± 2.38	3.05 ± 1.84	< MDL
HT-E	<i>max.</i>	< 1.15	1.28 ± 0.64	482 ± 300
	<i>avg.</i>	0.29 ± 0.91	0.81 ± 0.93	< MDL
HT-W	<i>max.</i>	1.25 ± 0.86	2.01 ± 0.72	< 280
	<i>avg.</i>	0.62 ± 1.23	1.71 ± 0.59	< MDL
HW	<i>max.</i>	< 1.14	1.61 ± 0.65	< 320
	<i>avg.</i>	0.47 ± 0.05	1.33 ± 0.56	< MDL
HZ	<i>max.</i>	< 1.63	1.38 ± 0.67	< 312
	<i>avg.</i>	0.6 ± 0.5	0.92 ± 0.9	< MDL
SDWA Limit		15	(a)	20,000

Notes:
 See Figure 5-3 for recharge basin/outfall locations.
 All values above MDL reported with a 95% confidence interval.
 Negative numbers occur when the measured value is lower than background (see Appendix B for description).
 To convert values from pCi to Bq, divide by 27.03.
 (a) The drinking water standard was changed from 50 pCi/L (concentration based) to 4 mrem/yr (dose based) in 2003. As gross beta activity does not identify specific radionuclides, a dose equivalent of this value cannot be calculated.
 MDL = minimum detection limit
 SDWA = Safe Drinking Water Act

limits, authorization for sewer system discharge is granted; if not, alternate means of disposal are used. Any waste that contains elevated levels of hazardous or radiological contaminants in concentrations that exceeded Laboratory effluent release criteria are sent to the BNL Waste Management Facility for proper management and off-site disposal.

5.4 RECHARGE BASINS

Recharge basins are used for the discharge of “clean” wastewater, including once-through cooling water, stormwater runoff, and cooling tower blowdown. These wastewaters are

Table 5-3. Water Quality Data for BNL On-Site Recharge Basin Samples.

ANALYTE	Recharge Basin									NYSDEC Effluent Standard	Typical MDL
	HN (RHIC)	HO* (AGS)	HS (s)	HT-W (Linac)	HT-E (AGS)	HW (s)	CSF (s)	HZ (s)			
<i>No. of samples</i>	2	2	2	2	2	2	2	2	2		
pH (SU)	<i>min.</i>	7.9	7.4	7.5	8	7.7	7.5	7.9	7.4	6.5 - 8.5	NA
	<i>max.</i>	8	7.4	7.8	8.3	7.8	8.1	8	7.5		
Conductivity (µS/cm)	<i>min.</i>	284	236	68	191	162	88	76	232	SNS	NA
	<i>max.</i>	1060	236	1096	534	406	194	303	239		
	<i>avg.</i>	672	236	582	362.5	284	141	189.5	235.5		
Temperature (°C)	<i>min.</i>	7.9	8.1	7.3	5.8	11	3.4	4.5	9.1	SNS	NA
	<i>max.</i>	25.5	8.1	23.7	23.3	24.2	23.8	23.4	21		
	<i>avg.</i>	16.7	8.1	15.5	14.6	17.6	13.6	14	15.1		
Dissolved oxygen (mg/L)	<i>min.</i>	7.6	10.9	8	8.5	8.6	8.3	8.5	9.2	SNS	NA
	<i>max.</i>	11.2	10.9	15.3	10.7	10.4	17.5	17	11.4		
	<i>avg.</i>	9.4	10.9	11.6	9.6	9.5	12.9	12.7	10.3		
Chlorides (mg/L)	<i>min.</i>	50	41	3	30	41	5.9	3.4	38	500	7.4
	<i>max.</i>	240	42	310	100	76	34	74	65		
	<i>avg.</i>	145	41.5	156.5	65	58.5	19.9	38.7	51.5		
Sulfates (mg/L)	<i>min.</i>	8	7.9	0.9	6.8	6.2	0.5	1.4	7.9	500	1.5
	<i>max.</i>	34	9.3	3.3	18	13	1.3	1.8	8.8		
	<i>avg.</i>	21	8.6	2.1	12.4	9.6	0.9	1.6	8.4		
Nitrate as nitrogen (mg/L)**	<i>min.</i>	< 0.05	0.29	0.18	< 0.05	< 0.05	0.1	0.12	0.3	10	0.05
	<i>max.</i>	< 0.05	0.29	0.18	< 0.05	< 0.05	0.1	0.12	0.3		
	<i>avg.</i>	< 0.05	0.29	0.18	< 0.05	< 0.05	0.1	0.12	0.3		

Notes:

See Figure 5-3 for recharge basin/outfall locations.

(s) = stormwater

AGS = Alternating Gradient Synchrotron

LINAC = Linear Accelerator

* = one sample taken w/exception of chlorides and sulfate

** = only one sample taken at all basins for Nitrate testing.

NA = not applicable

NYSDEC = New York State Department of Environmental Conservation

RHIC = Relativistic Heavy Ion Collider

SNS = effluent standard not specified

suitable for direct replenishment of the groundwater aquifer. Figure 5-3 shows the locations of the Laboratory’s discharges to recharge basins (also called “outfalls” under BNL’s SPDES permit). Figure 5-4 presents an overall schematic of potable water use at the Laboratory, and how much of this water is discharged to the 11 on-site recharge basins:

- Basins HN, HT-W, and HT-E receive once-through cooling water discharges generated at the Alternating Gradient Synchrotron (AGS), LINAC and Relativistic Heavy Ion Collider (RHIC), as well as cooling tower blowdown and stormwater runoff.
- Basin HS receives predominantly stormwa-

ter runoff, once-through cooling water from Building 555 (Chemistry Department), and minimal cooling tower blowdown from the Computational Science Initiative facility.

- Basin HX receives Water Treatment Plant filter backwash water.
- Basin HO receives cooling water discharges from the AGS and stormwater runoff from the area surrounding the High Flux Beam Reactor (HFBR).
- Several other recharge areas are used exclusively for discharging stormwater runoff. These areas include Basin HW near the National Synchrotron Light Source II (NSLS-II) site, Basin CSF at the Central Steam

Table 5-4. Metals Analysis of Water Samples from BNL On-Site Recharge Basins.

METAL	<i>Total (T) or Filtered (F)</i>	Recharge Basin								NYSDEC Effluent Limit or AWQS	Typical MDL
		HO (AGS/HFBR)		HT-E (AGS)		HT-W (Linac)		HZ (stormwater)			
		T	F	T	F	T	F	T	F		
<i>No. of samples</i>		2	2	2	2	2	2	2	2		
Ag Silver (µg/L)	<i>min.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	50	2
	<i>max.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	<i>avg.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Al Aluminum (µg/L)	<i>min.</i>	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	2000	50
	<i>max.</i>	< 50.0	< 50.0	84	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0		
	<i>avg.</i>	< 50.0	< 50.0	66.5	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0		
As Arsenic (µg/L)	<i>min.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	50	5
	<i>max.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	<i>avg.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Ba Barium (µg/L)	<i>min.</i>	< 20	< 20	49	< 20	< 20	< 20	< 20	< 20	2000	20
	<i>max.</i>	< 20	< 20	< 20	48	58	57	< 20	< 20		
	<i>avg.</i>	< 20	< 20	32.5	31.5	36	35.5	< 20	< 20		
Be Beryllium (µg/L)	<i>min.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	SNS	2
	<i>max.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	<i>avg.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Cd Cadmium (µg/L)	<i>min.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	10	2
	<i>max.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	<i>avg.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Co Cobalt (µg/L)	<i>min.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	5	5
	<i>max.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	<i>avg.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Cr Chromium (µg/L)	<i>min.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	100	10
	<i>max.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
	<i>avg.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
Cu Copper (µg/L)	<i>min.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	6.8	6.3	1000	10
	<i>max.</i>	< 10.0	< 10.0	< 10.0	< 10.0	13	11	36	30		
	<i>avg.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	21.4	18.2		
Fe Iron (mg/L)	<i>min.</i>	0.05	<0.05	0.07	0.05	0.08	<0.05	0.05	<0.05	0.6	0.05
	<i>max.</i>	0.09	0.05	0.35	0.07	<0.05	<0.05	0.17	0.17		
	<i>avg.</i>	0.07	<0.05	0.21	0.07	0.06	<0.05	0.11	0.1		
Hg* Mercury (µg/L)	<i>min.</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	1.4	0.2
	<i>max.</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2		
	<i>avg.</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2		
Mn Manganese (µg/L)	<i>min.</i>	4	2	2.4	1.9	4.2	2.7	4.4	4.3	600	3
	<i>max.</i>	4.2	4	10	4	5.3	6.3	5	4.4		
	<i>avg.</i>	4.1	3	6.2	2.9	4.8	4.5	4.7	4.4		

(continued on next page)

Table 5-4. Metals Analysis of Water Samples from BNL On-Site Recharge Basins (concluded).

METAL	Recharge Basin								NYSDEC Effluent Limit or AWQS	Typical MDL	
	HO (AGS/HFBR)		HT-E (AGS)		HT-W (Linac)		HZ (stormwater)				
	T	F	T	F	T	F	T	F			
<i>Total (T) or Filtered (F)</i>											
<i>No. of samples</i>	2	2	2	2	2	2	2	2	2		
Na Sodium (mg/L)	<i>min.</i>	25	27	27	28	19	19	26	25	SNS	0.25
	<i>max.</i>	26	27	61	60	79	78	43	42		
	<i>avg.</i>	25.5	27	44	44	49	48.5	34.5	33.5		
Ni Nickel (µg/L)	<i>min.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	200	10
	<i>max.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
	<i>avg.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
Pb Lead (µg/L)	<i>min.</i>	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	50	3
	<i>max.</i>	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	12	7.8		
	<i>avg.</i>	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	7.5	5.4		
Sb Antimony (µg/L)	<i>min.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	6	5
	<i>max.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	<i>avg.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Se Selenium (µg/L)	<i>min.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	20	5
	<i>max.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	<i>avg.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Tl Thallium (µg/L)	<i>min.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	SNS	5
	<i>max.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	<i>avg.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
V Vanadium (µg/L)	<i>min.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	SNS	5
	<i>max.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	<i>avg.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Zn Zinc (µg/L)	<i>min.</i>	< 20.0	< 20.0	< 20.0	< 20.0	22	21	31	29	5000	20
	<i>max.</i>	< 20.0	< 20.0	< 20.0	20	24	22	35	33		
	<i>avg.</i>	< 20.0	< 20.0	< 20.0	< 20.0	23	21.5	33	31		

Notes:

* = only one sample for mercury at HT-E was obtained
 See Figure 5-3 for recharge basin/outfall locations.
 AGS = Alternating Gradient Synchrotron

HFBR = High Flux Beam Reactor
 AWQS = Ambient Water Quality Standards
 LINAC = Linear Accelerator

Facility (CSF), Basin HW-M at the former Hazardous Waste Management Facility (FHWMF), and Basin HZ near Building 902. Recharge Basins HP and RAV are used for discharge of treated water from the groundwater remediation systems and are monitored under BNL’s Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) equivalency permits.

Each of the recharge basins is a permitted point-source discharge under the Laboratory’s

SPDES permit and equivalency permits under the CERCLA program. Where required by the permit, the basins are equipped with a flow monitoring station, allowing for weekly recordings of flow rates. The specifics of the SPDES compliance monitoring program are provided in Chapter 3. To supplement the monitoring program, samples are also routinely collected and analyzed under BNL’s Environmental Surveillance Program for radioactivity, VOCs, metals, and anions. During 2018, water samples were

Table 5-5. Radiological Results for Surface Water Samples Collected along the Peconic and Carmans Rivers.

Sampling Station		Gross Alpha	Gross Beta	Tritium	Strontium-90
		(pCi/L)			
HY (headwaters) on site, west of the RHIC ring	N	2	2	2	2
	max	< 0.99	2.31 ± 0.75	< 282	0.78 ± 0.47
	avg	0.69 ± 0.03	1.69 ± 1.22	<MDL	0.67 ± 0.22
HV (headwaters) on site, inside the RHIC ring	N	2	2	2	NS
	max	1.11 ± 0.69	2.2 ± 0.75	< 292	
	avg	0.76 ± 0.69	1.76 ± 0.87	<MDL	
HM-N downstream of STP on-site	N	1	1	1	1
	max	< 1.07	< 0.86	< 392	< 0.62
	avg	NA	NA	NA	NA
HM-S tributary, on-site	N	2	2	2	2
	max	1.04 ± 0.72	1.03 ± 0.6	< 288	< 1.07
	avg	0.97 ± 0.13	0.94 ± 0.17	<MDL	0.46 ± 0.23
HQ downstream of STP, at BNL site boundary	N	2	2	2	2
	max	< 1.58	2.08 ± 0.78	< 392	< 1.13
	avg	0.37 ± 0.13	2.04 ± 0.09	<MDL	0.53 ± 0.37
Carmans River HH control location, off site	N	2	2	2	2
	max	< 1.48	2.55 ± 0.82	< 453	0.29 ± 0.17
	avg	0.13 ± 0.14	1.65 ± 1.77	<MDL	0.15 ± 0.27
SDWA Limit (pCi/L)		15	(a)	20,000	8

Notes:

See Figure 5-1 sampling station locations.
 All values reported with a 95% confidence interval.
 To convert values from pCi to Bq, divide by 27.03.
 MDL = minimum detection limit
 N = number of samples analyzed
 NA = not applicable
 NS = not sampled due to dry conditions
 RHIC = Relativistic Heavy Ion Collider

SDWA = Safe Drinking Water Act
 STP = Sewage Treatment Plant
 (a) The drinking water standard was changed from 50 pCi/L (concentration based) to 4 mrem/yr (dose based) in 2003. Because gross beta activity does not identify specific radionuclides, a dose equivalent cannot be calculated for the values in the table

collected from all the basins listed above semi-annually except for recharge Basin HX at the Water Treatment Plant (due to previously documented non-impact to groundwater from plant operations) and recharge basin at the FHWMF (due to absence of operations at the FHWMF that could lead to the contamination of runoff).

5.4.1 Recharge Basins – Radiological Analyses

Discharges to the recharge basins were sampled semi-annually and analyzed for gross alpha and beta activity, gamma-emitting radionuclides, and tritium. The results are presented in Table 5-2. Gross alpha activity ranged from non-detect to 2.1 pCi/L and gross beta activity ranged from 1.27 ± 0.73 to 3.99 ± 1.52 pCi/L. Low-level detections of beta activity are attributable to naturally occurring radionuclides, such as

potassium-40 (K-40: half-life, 1.3E+09 years). No gamma-emitting nuclides attributable to BNL operations or tritium were detected in any discharges to recharge basins. The maximum value for tritium was 482 ± 300 pCi/L well below the 20,000 pCi/L drinking water standard.

5.4.2 Recharge Basins – Nonradiological Analyses

During 2018, discharge samples were collected semi-annually for water quality parameters, metals, and VOCs. Field-measured parameters (e.g. pH, conductivity, and temperature) were routinely monitored and recorded. The water quality and metals analytical results are summarized in Tables 5-3 and 5-4, respectively. The nonradiological analytical results are compared to groundwater discharge standards promulgated under Title 6 of the New York Codes, Rules,

Table 5-6. Water Quality Analytical Results for Surface Water Samples Collected Along the Peconic and Carmans Rivers.

Analyte	Peconic River Station Locations					Carmans River HH (Control)	NYSDEC Effluent Standard	Typical MDL
	HY	HM-N	HM-S	HQ				
<i>No. of samples</i>	2	1	2	2	2			
pH (SU)	<i>min.</i>	4.8	NA	4.1	4.8	6.8	6.5 - 8.5	NA
	<i>max.</i>	5.7	6.2	4.3	6.8	8.3		
Conductivity (μS/cm)	<i>min.</i>	29	NA	25	107	232	SNS	NA
	<i>max.</i>	45	176	66	181	242		
	<i>avg.</i>	37	NA	45.5	144	237		
Temperature (°C)	<i>min.</i>	5.7	NA	6.1	2.1	5	SNS	NA
	<i>max.</i>	6.1	6.5	10.6	6.2	20.5		
	<i>avg.</i>	5.9	NA	8.4	4.2	12.8		
Dissolved oxygen (mg/L)	<i>min.</i>	1.9	NA	9.1	10.3	8.6	> 4.0	NA
	<i>max.</i>	12.4	6	11	11.5	12.1		
	<i>avg.</i>	7.1	NA	10	10.9	10.4		
Chlorides (mg/L)	<i>min.</i>	8.5	NA	4.9	NA	44	250 (a)	1.8
	<i>max.</i>	9.5	11	5.8	13	50		
	<i>avg.</i>	9	NA	5.4	NA	47		
Sulfate (mg/L)	<i>min.</i>	1.6	NA	0.7	9.6	11	250 (a)	0.5
	<i>max.</i>	2	4.4	1.4	12.2	13		
	<i>avg.</i>	1.8	NA	1.05	10.9	12		
Nitrate as nitrogen (mg/L)	<i>min.</i>	< 0.05	NA	< 0.05	< 0.02	0.14	10 (a)	0.05
	<i>max.</i>	< 0.05	0.08	< 0.05	< 0.05	0.14		
	<i>avg.</i>	< 0.05	NA	< 0.05	< 0.05	0.14		

Notes:

See Figure 5-1 for monitoring locations.
 HY = Peconic River headwaters, on site, east of Wm Floyd Pkwy.
 HM-N = Peconic River main channel at east firebreak
 HM-S = Peconic River tributary at east firebreak

HH = Carmans River control location, off site
 NA = not applicable
 NYSDEC = New York State Department of Environmental Conservation
 SNS = effluent standard not specified
 (a) Since there are no NYSDEC Class C surface Ambient Water Quality Standards (AWQS) for these compounds, the AWQS for Class GA groundwater is provided for reference.

and Regulations (NYCRR), Part 703.6.

Low concentrations of disinfection byproducts were periodically detected above method detection limits in discharges to several of the basins throughout the year. Sodium hypochlorite and bromine, used to control bacteria in the drinking water and algae in cooling towers, can breakdown to bromoform, chloroform, dibromochloromethane, and dichlorobromomethane. Concentrations of most disinfection byproducts were less than method detection limits with the exception of bromoform with all values less than 12 μ g/L. No other VOCs were detected

above method detection limits in any of the discharges to the recharge basins.

The analytical data presented in Table 5-3 show that, for 2018, the concentrations of all analytes were within effluent standards, including chlorides. Historically, chlorides are found to be higher in samples collected during the winter and are attributed to road salt used to control snow and ice buildup. The mild conditions during winter months in 2018 resulted in lower salt use. The data in Table 5-4 show that all parameters complied with the respective water quality or groundwater discharge standards.

Table 5-7: Metals Analytical Results for Surface Water Samples Collected Along the Peconic and Carmans Rivers.

METAL	Peconic River Locations										NYSDEC AWQS (a)	Typical MDL	
	HY		HM-N		HM-S		HQ		HH(Control)				
	T	D	T	D	T	D	T	D	T	D			
<i>Total (T) or Dissolved (D)</i>													
<i>No. of samples</i>	2	2	1	1	2	2	1	1	2	2			
Ag (I) Silver (µg/L)	<i>min.</i>	< 2.0	< 2.0	-	-	< 2.0	< 2.0	-	-	< 2.0	< 2.0	0.1	2
	<i>max.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	<i>avg.</i>	< 2.0	< 2.0	-	-	< 2.0	< 2.0	-	-	< 2.0	< 2.0		
Al (I) Aluminum (µg/L)	<i>min.</i>	460	370	-	-	750	640	-	-	81	<50.0	100	50
	<i>max.</i>	660	540	250	270	910	990	400	350	160	<50.0		
	<i>avg.</i>	560	455	-	-	830	815	-	-	120.5	<50.0		
As (D) Arsenic (µg/L)	<i>min.</i>	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0	150	5
	<i>max.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	<i>avg.</i>	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0		
Ba Barium (µg/L)	<i>min.</i>	< 20.0	< 20.0	-	-	< 20	< 20	-	-	32	30	SNS	20
	<i>max.</i>	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	45	52		
	<i>avg.</i>	< 20.0	< 20.0	-	-	< 20.0	< 20.0	-	-	38.5	41		
Be (AS) Beryllium (µg/L)	<i>min.</i>	< 2.0	< 2.0	-	-	< 2.0	< 2.0	-	-	< 2.0	< 2.0	11	2
	<i>max.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	<i>avg.</i>	< 2.0	< 2.0	-	-	< 2.0	< 2.0	-	-	< 2.0	< 2.0		
Cd (D) Cadmium (µg/L)	<i>min.</i>	< 2.0	< 2.0	-	-	< 2.0	< 2.0	-	-	< 2.0	< 2.0	1.1	2
	<i>max.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	<i>avg.</i>	< 2.0	< 2.0	-	-	< 2.0	< 2.0	-	-	< 2.0	< 2.0		
Co (AS) Cobalt (µg/L)	<i>min.</i>	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0	5	5
	<i>max.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	<i>avg.</i>	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0		
Cr (I) Chromium (µg/L)	<i>min.</i>	< 10.0	< 10.0	-	-	< 10.0	< 10.0	-	-	< 10.0	< 10.0	34	10
	<i>max.</i>	11	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
	<i>avg.</i>	< 10.0	< 10.0	-	-	< 10.0	< 10.0	-	-	< 10.0	< 10.0		
Cu (D) Copper (µg/L)	<i>min.</i>	< 10.0	< 10.0	-	-	< 10.0	< 10.0	-	-	< 10.0	< 10.0	4	10
	<i>max.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	14	< 10.0		
	<i>avg.</i>	< 10.0	< 10.0	-	-	< 10.0	< 10.0	-	-	12	< 10.0		
Fe (AS) Iron (mg/L)	<i>min.</i>	0.21	0.14	-	-	0.29	0.2	-	-	0.31	0.2	0.3	0.05
	<i>max.</i>	0.52	0.36	0.4	0.35	0.56	0.66	0.55	0.45	0.39	0.21		
	<i>avg.</i>	0.36	0.25	-	-	0.43	0.43	-	-	0.35	0.21		
Hg (D) Mercury (µg/L)	<i>min.</i>	< 0.2	< 0.2	-	-	< 0.2	< 0.2	-	-	< 0.2	< 0.2	0.2	0.2
	<i>max.</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2		
	<i>avg.</i>	< 0.2	< 0.2	-	-	< 0.2	< 0.2	-	-	< 0.2	< 0.2		
Mn Manganese (µg/L)	<i>min.</i>	60	58	-	-	22	25	-	-	25	28	SNS	2
	<i>max.</i>	80	75	16	18	25	29	22	20	96	91		
	<i>avg.</i>	70	66.5	-	-	23.5	27	-	-	60.5	59.5		
Na Sodium (mg/L)	<i>min.</i>	5.6	5.5	-	-	2.6	2.8	-	-	25	24	SNS	0.25
	<i>max.</i>	6.1	5.7	7.6	8.7	3.2	3.6	12	12	27	34		
	<i>avg.</i>	5.85	5.6	-	-	2.9	3.2	-	-	26	29		

(continued on next page)

Table 5-7: Metals Analytical Results for Surface Water Samples Collected Along the Peconic and Carmans Rivers (concluded).

METAL	Peconic River Locations										NYSDEC AWQS (a)	Typical MDL	
	HY		HM-N		HM-S		HQ		HH(Control)				
Total (T) or Dissolved (D)	T	D	T	D	T	D	T	D	T	D			
No. of samples	2	2	1	1	2	2	1	1	2	2			
Ni (D) Nickel (µg/L)	min.	< 10.0	< 10.0	-	-	< 10.0	< 10.0	-	-	< 10.0	< 10.0	23	10
	max.	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
	avg.	< 10.0	< 10.0	-	-	< 10.0	< 10.0	-	-	< 10.0	< 10.0		
Pb (D) Lead (µg/L)	min.	< 3.0	< 3.0	-	-	< 3.0	< 3.0	-	-	< 3.0	< 3.0	0.1	2.7
	max.	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0		
	avg.	< 3.0	< 3.0	-	-	< 3.0	< 3.0	-	-	< 3.0	< 3.0		
Sb Antimony (µg/L)	min.	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0	SNS	5
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0		
Se (D) Selenium (µg/L)	min.	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0	4.6	5
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0		
Tl (AS) Thallium (µg/L)	min.	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0	8	5
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0		
V (AS) Vanadium (µg/L)	min.	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0	14	5
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	-	-	< 5.0	< 5.0	-	-	< 5.0	< 5.0		
Zn (D) Zinc (µg/L)	min.	< 20.0	< 20.0	-	-	< 20.0	< 20.0	-	-	< 20.0	< 20.0	37	20
	max.	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0	50	43	< 20.0	< 20.0		
	avg.	< 20.0	< 20.0	-	-	< 20.0	< 20.0	-	-	< 20.0	< 20.0		

Notes:
See Figure 5-1 sampling station locations.
AWQS = Ambient Water Quality Standards
AS = Acid Soluble
NA = not applicable

SNS = effluent standard not specified for these elements in Class C surface waters
(a) NYS AWQS for Class C surface waters

5.4.3 Stormwater Assessment

All recharge basins receive stormwater runoff. Stormwater at BNL is managed by collecting runoff from paved surfaces, roofs, and other impermeable surfaces and directing it to recharge basins via underground piping and above-grade vegetated swales. Recharge Basin HS receives most of the stormwater runoff from the central, developed portion of the Laboratory site. Basins HN, HZ, HT-W, and HT-E receive runoff from the Collider-Accelerator complex. Basin HO receives runoff from the area surrounding the HFBR. Basin CSF receives runoff from the CSF area and along Cornell Avenue east of Renaissance Road. Basin HW receives runoff from the

NSLS-II site, and HW-M receives runoff from the fenced area at the FHWMF.

Stormwater runoff at the Laboratory typically has elevated levels of inorganics (i.e., metals) and has a low pH. The inorganics are attributable to high sediment content in stormwater (inorganics occur naturally in native soil). In an effort to further improve the quality of stormwater runoff on site, BNL has formal procedures for managing and maintaining outdoor work and storage areas. The requirements include covering of equipment and materials (e.g., road salt storage and bins/containers with potential to leak residual oils or any other hazardous materials) to prevent contact with stormwater,

conducting an aggressive maintenance and inspection program, implementing erosion control measures during soil disturbance activities, and restoring these areas when operations cease. Basin sediment sampling is conducted on a five-year testing cycle to ensure these discharges comply with regulatory requirements. Basin sediments were last sampled in 2017 and data were presented in Chapter 6 of the 2017 SER. The next sampling event will occur in 2022.

5.5 PECONIC RIVER SURVEILLANCE

Several locations are monitored along the Peconic River to assess the overall water quality of the river and assess any impact from BNL operations. Sampling points along the Peconic River are identified in Figure 5-1. In total, five stations (two upstream and three downstream of the former STP discharge) were sampled in 2018. A sampling station along the Carmans River (HH) was also monitored as a geographic control location, not affected by Laboratory operations or located within the Peconic River watershed. The following locations were monitored for radiological and nonradiological parameters:

Upstream sampling station:

- HY, on site, immediately east of the William Floyd Parkway
- HV, on site, just east of the 10 o'clock experimental hall in the RHIC Ring

Downstream sampling stations:

- HM-N, on site, at east firebreak
- HM-S, on site, at east firebreak south of mainstem of Peconic
- HQ, on site, at east boundary of BNL

Control location:

- HH, Carmans River

5.5.1 Peconic River – Radiological Analyses

During 2018, radionuclide analyses were performed on surface water samples collected from the five Peconic River sampling locations and the Carmans River control location. The majority of the Peconic River on site held water for at least part of 2018. The radiological data from Peconic River surface water samples are

summarized in Table 5-5. Radiological analysis of water samples collected from all locations had very low concentrations of gross alpha and gross beta activity that were attributed to natural sources. All detected levels were below the applicable NYS DWS. No gamma-emitting radionuclides attributable to Laboratory operations were detected, and neither tritium or Sr-90 was detected above method detection limits in any of the samples.

5.5.2 Peconic River – Nonradiological Analyses

River water samples collected in 2018 were analyzed for water quality parameters (e.g., pH, temperature, conductivity, and dissolved oxygen), anions (e.g., chlorides, sulfates, and nitrates), metals, and VOCs. The analytical data for the Peconic River and Carmans River samples are summarized in Table 5-6 (water quality) and Table 5-7 (metals). There were no VOCs detected above the method detection limits in any samples collected from the Peconic River or Carmans River stations in 2018.

Water quality parameters measured in the four Peconic River locations and the Carmans River control location (HH) show that pH, temperature, conductivity, and dissolved oxygen levels were within applicable NYS standards with the exception of a single dissolved oxygen reading of 1.9 mg/L taken at station HY just off the William Floyd Parkway.

Ambient water quality standards (AWQS) for metallic elements are based on their solubility state. Certain metals are only biologically available to aquatic organisms if they are in a dissolved or ionic state, whereas other metals are toxic in any form (i.e., dissolved and particulate combined). In 2018, the BNL monitoring program continued to assess water samples for both the dissolved and particulate form. Dissolved concentrations were determined by filtering the samples prior to acid preservation and analysis. Examination of the total (i.e., particulate form) metals data showed that aluminum, iron, and zinc were present in concentrations at some locations that exceeded NYS AWQS. Aluminum and iron were detected throughout the Peconic and Carmans River systems at concentrations that exceed the NYS AWQS in both the filtered

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and unfiltered fractions. Iron and aluminum were found in high concentrations in native Long Island soil and, for iron, at high levels in groundwater. Levels of zinc at concentrations greater than the NYS AWQS were found in samples collected at station HQ, which is located on the eastern boundary of the Lab. Filtration of the samples reduced concentrations for some metals at or below the NYS AWQS, indicating

that most detections were due to sediment suspended in the samples.

REFERENCES AND BIBLIOGRAPHY

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